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(54) **A METHOD AND A DEVICE FOR SEALING BETWEEN A CASING AND A DRILL HOLE IN ROCK DRILLING OPERATIONS**

VERFAHREN UND VORRICHTUNG ZUM HERSTELLEN EINER ABDICHTUNG ZWISCHEN VERROHRUNG UND BOHRLOCH BEI GESTEINSBOHRARBEITEN

PROCEDE ET DISPOSITIF D'ETANCHEITE ENTRE UN CUVELAGE ET UN FORAGE DANS DES OPERATIONS DE FORAGE DE ROCHE

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Description

The subject invention concerns a method and a device in rock drilling wherein a casing provided with a rigid front end portion is lowered concurrently with the drilling to seal said casing front end portion from the wall of the drilled hole.

In drilling wells, for example water wells or energy wells, it is often very important that surface water and pollutants do not stream into the drill hole. In order to prevent this from happening, it is common practice to force a casing through the earth stratum and through the uppermost rock strata, which often are cracked and consequently constitute possible risks that surface water and pollutants entrained therein penetrate into the drill hole. In accordance with one prior-art method the casing may be pulled down through the drill hole concurrently with the very drilling thereof. One type of such simultaneous drilling and pulling down of the casing is the method known as the ODEX Method. According to this, the casing which could be made from e.g. a plastics material, is fitted at its lower end with an end sleeve of metal or some other heavier material. The end sleeve may be attached to the casing by means of rivets or screws when the casing is made of plastics. If the casing is made of metal, the end sleeve could also be attached thereto by means of welding. In accordance with the prior-art method, the end sleeve is formed at its top with a shoulder projecting beyond the inner wall of the casing against which abuts a portion of a drill tool rotating inside the casing interior. A central drill bit as well as a so called reamer project below the lower end of the end slevee, and upon rotation of the drill in one direction the reamer is forced to expand in the radial direction in such a manner that it becomes possible to perform drilling operations below the end sleeve for reaming a drill hole the diameter of which exceeds that of the casing. Because of the abutment of the drill body against the end sleeve shoulder the casing is pulled downwards simultaneously with the drilling at the pace of the drilling operations. When the casing reaches the desired depth, the drill tool is rotated in the opposite direction, whereby the reamer is retracted in the radial direction in such a manner that the drill tool together with the drill bit may be pulled upwards in the interior of the casing.

When drilling in this manner, water and drill cuttings are fed upwards, mainly in the interior of the casing, but material loosened from the rock is advanced upwards also in the gap between the casing and the drill hole wall. In order to provide the sealing effect referred to above between the casing and the drill hole to prevent penetration of surface water and other pollutants, it is known to fit the lower casing sleeve with external rubber seals, often having rubber lips engaging the drill hole wall. During the drilling and the simultaneous pulling downwards of the casing, these seals are, however, often subjected to damages from the material which, during the drilling, is forced past the seals upwards in the space between the casing and the drill hole. By the time the drilling is completed these seals are damaged to such an extent that they no longer are capable of fulfilling the sealing purpose for which they were originally intended. Another disadvantage inherent in the prior-art seals is that owing to their permanent engagement with the drill hole wall, the rubber lips offer a non-desirable resistance against the pulling-down of the casing.

The main purpose of the invention is to provide a method and a device whereby these disadvantages are eliminated, i.e. an arrangement which allows the casing to be driven down into the drill hole during the drilling without encountering much resistance and, upon completed drilling, provides efficient sealing between the casing and the drill hole.

This purpose is achieved in that in one or several external peripheral grooves formed in the end part of the casing, annular members are lodged, said members being of a material which expand with delay when moistened.

In order to allow unimpeded lowering of the casing during the time the drilling of the casing hole is in progress, the expandable material may be coated with a delay layer which only slowly dissolves upon its contact with liquids, thus preventing or at least counter-acting the expansion of the material during the time required to effect the drilling including the simultaneous lowering of the casing.

Preferably, the peripheral grooves in the end portion of the casing are formed with walls presenting an obliquely upwards-directed slope towards the drill hole wall. In addition to providing a barb-like retainment force to hold firm the casing in the drill hole wall, this arrangement likewise creates an area of abutment against the drill hole wall that is comparatively extensive vertically in relation to the width of the grooves. In addition, the risk of drill cuttings and other material penetrating into the grooves and in doing so impairing the subsequent sealing effect is reduced.

The invention will be described more in detail in the following by way of one example, with reference to the accompanying drawings, wherein:

Fig. 1 illustrates the lower portion of a drilling tool while reaming a drill hole to allow positioning therein of a casing;

Fig. 2 illustrates the same part of the drill hole with a casing in position and the drill tool being retracted through the casing;

Fig. 3 illustrates the casing in sealing position against the corresponding drill hole wall, and

Fig. 4 illustrates on a smaller scale the extension of the casing through the upper fissured rock strata and the further extension downwards of the drill hole through the rock.

Figs. 1 and 2 illustrate a drilling operation including simultaneous lowering of a casing 1 in accordance with

the ODEX method referred to previously. The casing 1 could for instance be made from steel but very often it is made from a softer material, such as a plastics material. Reference numeral 2 designates an end sleeve the upper portion of which is inserted into the interior of the casing 1 and which preferably is attached to the casing by means of screws, rivets or the like. When the casing 1 is made from steel, the end sleeve 2 could of course also be welded to the casing. The sleeve 2 is formed with a number of peripheral grooves 3 the side walls of which, in accordance with the embodiment shown, extend obliquely upwards, towards the hole wall 4. In each one of the grooves 3 an annular member 5 is inserted, the material of said members preferably being a rubber material of a kind which expands when moistened. The expandable material of the annular members preferably consists of a chloroprene material, for instance a material of the kind marketed under the trade name "Hydrotight". On the expandable material of the annular members could be applied a surface coating which is slowly dissolved by liquid for the purpose of delaying the contact liquid/expandable material and thus also delaying its expansion effect. Naturally, it is also possible to formulate the expandable material itself in such a manner that a suitable expansion delay effect is achieved. Preferably, the annular members 5 are dimensioned so as to be completely or at least almost completely housed inside the grooves 3. The upper end edge 6 of the end sleeve 2 forms an upwardly directed shoulder against which abuts a downwardly facing collar 7 on a guide member 8 on the drilling tool. The guide member 8 serves as a mounting piece on which a shaft 9 is fitted, the upper end of said shaft being connected above the drill hole to a drive unit, not illustrated in the drawings. At its lower end, the drilling tool is provided with a drill head 10 above which a reamer 11 is disposed. The reamer 11 is mounted on the shaft 9 in such a manner between the drill head 10 and the mounting sleeve 8 that upon its rotation in one direction it is expanded radially and is maintained in this position, i.e. the position illustrated in Fig. 1, whereas upon its rotation in the opposite direction it is retracted, assuming a smaller external diameter size than the inner diameter size of the end sleeve 2. In the latter position the entire tool may be pulled upwards through the sleeve 2 and the drill hole as illustrated in Fig. 2. During drilling operations, the drill head 10 including the reamer 11 are driven into the rock. The reamer 11 first widens the drill hole below the casing and the end sleeve 2 to a diameter size exceeding the diameter of the latter by a suitable clearance a which preferably is sufficiently large to allow the casing 1, during the drilling operation, to be lowered inside the drill hole without encountering unnecessary resistance. Drill cuttings loosened by the drill head 10 and the reamer 11 are forced upwards together with liquid, if any, through a longitudinal groove 12 formed in the peripheral surface of the mounting sleeve 8, into the space within the casing 1, to be further conveyed upwards through the latter. During the drilling, some drill cuttings also flow upwards in the gap a between the end sleeve 2 and the wall of the drill hole 4. The material flowing upwards inside the space a easily slides past the annular sealing members 5 without causing any damage thereto. Owing to the slope of the walls of the grooves 3 the lower groove wall efficiently protects the corresponding annular member 5 whereas the upper groove wall serves as a sliding surface on which slides the material flowing upwards. Because the mounting sleeve 8 together with its collar 7 is supported against the shoulder 6 of the end sleeve 2, the casing is forced to accompany the drill tool as the latter moves downwards.

When the drilling to accommodate the casing is completed, the shaft 9 is rotated in the opposite direction, whereupon the reamer 11 is retracted to the position illustrated in Fig. 2, and the drilling tool is lifted through the casing 1, the latter being either left in the position corresponding to the position in Fig. 2 or being lowered further into the drill hole 4 into abutment against the ledge 13 formed between the drill hole 4 excavated by the reamer and the drill hole 14 excavated by the drill head 10.

The material of the annular members 5 is chosen to ensure that the expansion thereof is delayed until the drilling operation referred to above is completed. Should any water exist in the excavated drill hole the expansion of the annular members 5 will occur automatically. In case no water yet exists in the drill hole water is supplied through the drill hole. The presence of water makes the annular members expand with delayed effect and assume the condition illustrated in Fig. 3, wherein the expanded annular members abut tightly against the wall of the drill hole 4, thus forming efficient seals. Owing to the oblique configuration of the grooves 3 the annular members are given a vertically expanded surface of contact against the drill hole wall 4 and they efficiently follow the wall contour. At the same time, the major expansion is directed upwards, which means that the casing is retained in position inside the drill hole as if by barbs.

When the casing has thus been placed in position the drilling continues to the desired depth by means of a drilling tool, which preferably corresponds to the lower part 14 of the drill hole already excavated, i.e. to approximately the interior of the end sleeve 2. This continued drilling operation may be effected immediately, or simultaneously with or after the expansion of the annular sealing members. Obviously, the hole could be drilled to a smaller diameter size. As illustrated in Fig. 4, any cracks 15 occurring in the rock are spanned by the casing the lower end of which is sealed off against the rock. In this manner surface water and other pollutants are efficiently prevented from penetrating into the drilling hole which thus may be kept clean for a very long time.

The prior-art method described above for excavating the hole in which the casing may be inserted is but one suitable example and should not be regarded to limit

the applicability of the inventive object.

It is of course possible to use other methods involving simultaneous drilling and insertion of the casing. Also, the number of grooves housing the annular sealing members could be adjusted to the local need and thus be both higher or lower than the number shown in the drawings.

Claims

1. A sealing method in rock drilling according to which a casing (1) provided with a rigid front end portion (2) is lowered into the drill hole simultaneously with the drilling, to seal said casing front end from the wall (4) of the drilled hole, **characterized** in that annular members (5) of a material that expands with delay when moistened are lodged in one or several external peripheral grooves formed in said end portion (2) of the casing.

2. A sealing method as claimed in claim 1, **characterized** in that the expandable material is coated with a delay layer which dissolves slowly upon its contact with liquid.

3. A sealing method as claimed in claim 1 or 2, **characterized** in that the composition of the expandable material is chosen to ensure that the expansion time for bridging the gap (a) between the casing (1, 2) and the surrounding drill hole wall (4) exceeds the time required for the drilling and/or the driving down of the casing to the desired depth.

4. A sealing method as claimed in any one of the preceding claims, **characterized** in that the peripheral grooves (3) formed in the end portion (2) of the casing are formed with the groove walls extending obliquely upwards, towards the drill hole wall (4).

5. A sealing device for use in rock drilling of the kind wherein a casing (1) provided with a rigid front end portion (2) is lowered concurrently with the drilling, to effect sealing between said casing and the surrounding drill hole wall (4), **characterized** in that it comprises a casing end portion (2) having external peripheral grooves (3) formed therein and annular members (5) in said grooves (3), said annular members inserted into said grooves in advance or in connection with the lowering of the casing into the drill hole and said annular members (5) being of a material that expands when moistened, the outer diameter of said annular members (5) in said peripheral grooves having an external diameter in their non-moistened condition which with a clearance is smaller than the drill hole wall positioned exteriorly thereof.

6. A device as claimed in claim 5, **characterized** in that the lateral walls of the peripheral grooves (3) are oblique so as to incline upwards towards the wall of the drill hole (4) when the casing is in its driven-down condition.

7. A device as claimed in claim 5 or 6, **characterized** in that the annular members (5) inserted in the grooves (3) have an external diameter size when in their non-expanded condition which is smaller than the external diameter of the casing portion (2) in which they are housed.

8. A device as claimed in claim 7, **characterized** in that the annular members (5) consist of a chloroprene material.

9. A device as claimed in any one of claims 5-8, **characterized** in that the annular members (5) have a core of an exandable material which is coated by an external delay layer which is dissolved slowly by liquid in order to delay contact between the liquid and the expandable material and thus to delay the expansion effect thereof.

10. A device as claimed in any one of claims 5-7, **characterized** in that the grooved casing portion (2) is a separate sleeve which may be attached to the rest of the casing.

Patentansprüche

1. Abdichtverfahren bei Gesteinsbohrungen, gemäss dem eine mit einem starren Vorderendteil (2) versehene Verrohrung (1) gleichzeitig mit dem Bohren in das Bohrloch abgesenkt wird, um das Vorderende der Verrohrung gegen die Wand (4) des gebohrten Lochs abzudichten, dadurch gekennzeichnet, dass ringförmige Glieder (5) aus einem Material, dass sich bei Befeuchtung mit Verzögerung ausdehnt, in einer oder mehreren äusseren Umfangsnuten, die in dem Endteil (2) der Verrohrung ausgebildet sind, angebracht sind.

2. Abdichtverfahren nach Anspruch 1, dadurch gekennzeichnet, dass das ausdehnbare Material mit einer Verzögerungsschicht überzogen ist, die sich bei Kontakt mit Flüssigkeit langsam auflöst.

3. Abdichtverfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass die Zusammensetzung des ausdehnbaren Materials so ausgewählt ist, dass gewährleistet ist, dass die Ausdehnungszeit zur Überbrückung des Spalts (a) zwischen der Verrohrung (1, 2) und der umgebenden Bohrlochwand (4) die zum Bohren und/oder Hinuntertreiben der Verrohrung auf die gewünschte Tiefe erforderliche Zeit

überschreitet.

4. Abdichtverfahren nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die in dem Endteil (2) der Verrohrung ausgebildeten Umfangsnuten (3) so ausgebildet sind, dass sich die Nutenwände schräg nach oben zur Bohrlochwand (4) hin erstrecken.

5. Abdichtvorrichtung zur Verwendung bei Gesteinsbohrungen jener Art, bei der eine mit einem starren Vorderendteil (2) versehene Verrohrung (1) gleichzeitig mit dem Bohren abgesenkt wird, damit eine Abdichtung zwischen der Verrohrung und der umgebenden Bohrlochwand (4) bewirkt wird, dadurch gekennzeichnet, dass sie einen Verrohrungsendteil (2) mit darin ausgebildeten äusseren Umfangsnuten (3) und ringförmige Glieder (5) in den Nuten (3) umfasst, wobei die ringförmigen Glieder vorher oder in Verbindung mit dem Absenken der Verrohrung in das Bohrloch in die Nuten eingesetzt werden und die ringförmigen Glieder (5) aus einem Material bestehen, das sich bei Befeuchtung ausdehnt, wobei der Aussendurchmesser der ringförmigen Glieder (5) in den Umfangsnuten in ihrem nicht befeuchteten Zustand bei einem Abstand kleiner ist als die ausserhalb davon positionierte Bohrlochwand.

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, dass die Seitenwände der Umfangsnuten (3) derart schräg sind, dass sie zur Wand des Bohrlochs (4) hin nach oben geneigt sind, wenn sich die Verrohrung in ihrem nach unten getriebenen Zustand befindet.

7. Vorrichtung nach Anspruch 5 oder 6, dadurch gekennzeichnet, dass die in den Nuten (3) eingesetzten ringförmigen Glieder (5) in ihrem nicht ausgedehnten Zustand einen Aussendurchmesser aufweisen, der kleiner ist als der Aussendurchmesser des Gehäuseteils (2), in dem sie untergebracht sind.

8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, dass die ringförmigen Glieder (5) aus Chloroprenmaterial bestehen.

9. Vorrichtung nach einem der Ansprüche 5 - 8, dadurch gekennzeichnet, dass die ringförmigen Glieder (5) einen Kern aus einem ausdehnbaren Material aufweisen, der mit einer äusseren Verzögerungsschicht überzogen ist, die durch Flüssigkeit langsam aufgelöst wird, damit Kontakt zwischen der Flüssigkeit und dem ausdehnbaren Material und somit seine Ausdehnungswirkung verzögert wird.

10. Vorrichtung nach einem der Ansprüche 5 - 7, dadurch gekennzeichnet, dass es sich bei dem genuteten Verrohrungsteil (2) um eine getrennte Hülse handelt, die an dem Rest der Verrohrung befestigt werden kann.

Revendications

1. Procédé d'étanchéification dans la perforation de roches, conformément auquel on fait descendre un tubage (1) muni d'une portion terminale frontale rigide (2) dans le trou de forage simultanément au forage, pour étancher ladite extrémité frontale de tubage par rapport à la paroi (4) du trou foré, caractérisé en ce que des éléments annulaires (5) en une matière qui se dilate à retardement lorsqu'elle est humidifiée, sont logés dans une ou plusieurs rainures périphériques externes pratiquées dans ladite portion terminale (2) du tubage.

2. Procédé d'étanchéification selon la revendication 1, caractérisé en ce que la matière expansible est revêtue d'une couche à retardement qui se dissout lentement lors de son contact avec un liquide.

3. Procédé d'étanchéification selon la revendication 1 ou 2, caractérisé en ce que la composition de la matière expansible est sélectionnée pour garantir le fait que le temps de dilatation requis pour remplir l'espace libre (a) ménagé entre le tubage (1, 2) et la paroi (4) du trou de forage environnant excède le temps requis pour le forage et/ou le guidage vers le bas du tubage jusqu'à la profondeur désirée.

4. Procédé d'étanchéification selon l'une quelconque des revendications précédentes, caractérisé en ce que la forme des rainures périphériques (3) pratiquées dans la portion terminale (2) du tubage épouse celle des parois rainurées s'étendant en oblique vers le haut, en direction de la paroi (4) du trou de forage.

5. Dispositif d'étanchéification à utiliser dans la perforation de roches, du type dans lequel on fait descendre un tubage (1) muni d'une portion terminale frontale rigide (2) de manière concourante avec le forage pour réaliser une étanchéification entre ledit tubage et la paroi (4) du trou de forage environnant, caractérisé en ce qu'il comprend une portion terminale de tubage (2) dans laquelle sont pratiquées des rainures périphériques externes (3), des éléments annulaires (5) étant disposés dans lesdites rainures (3), lesdits éléments annulaires étant insérés dans lesdites rainures au préalable ou de concert avec la descente du tubage dans le trou de forage, et lesdits éléments annulaires (5) étant réalisés en une matière qui se dilate à l'état humidifié,

lesdits éléments annulaires (5) dans lesdites rainures périphériques possédant un diamètre externe à leur état non humidifié qui, avec du jeu, est inférieur à celui de la paroi du trou de forage positionnée à l'extérieur de ces éléments.

6. Dispositif selon la revendication 5, caractérisé en ce que les parois latérales des rainures périphériques (3) sont obliques de façon à s'incliner vers le haut en direction de la paroi du trou de forage (4) lorsque le tubage se trouve dans l'état dans lequel il est guidé vers le bas.

7. Dispositif selon la revendication 5 ou 6, caractérisé en ce que les éléments annulaires (5) insérés dans les rainures (3) possèdent une dimension de diamètre externe à l'état non dilaté qui est inférieure à celle du diamètre externe de la portion de tubage (2) dans laquelle ils sont logés.

8. Dispositif selon la revendication 7, caractérisé en ce que les éléments annulaires (5) sont constitués par une matière de chloroprène.

9. Dispositif selon l'une quelconque des revendications 5 à 8, caractérisé en ce que les éléments annulaires (5) possèdent une partie centrale en une matière expansible qui est revêtue d'une couche externe à retardement qui se dissout lentement au contact d'un liquide dans le but de retarder le contact entre le liquide et la matière expansible et ainsi, retarder son effet de dilatation.

10. Dispositif selon l'une quelconque des revendications 5 à 7, caractérisé en ce que la portion de tubage rainurée (2) est un manchon séparé qui peut être fixé au reste du tubage.

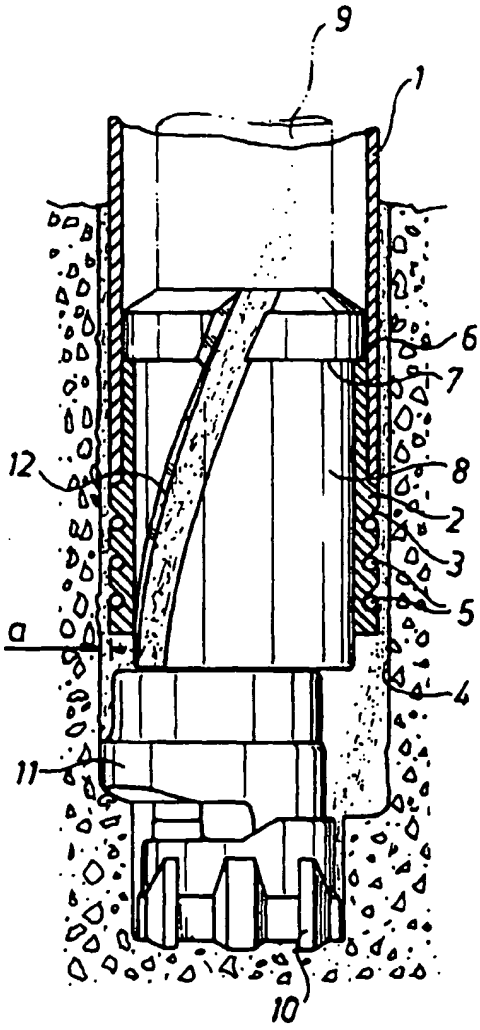

Fig. 1

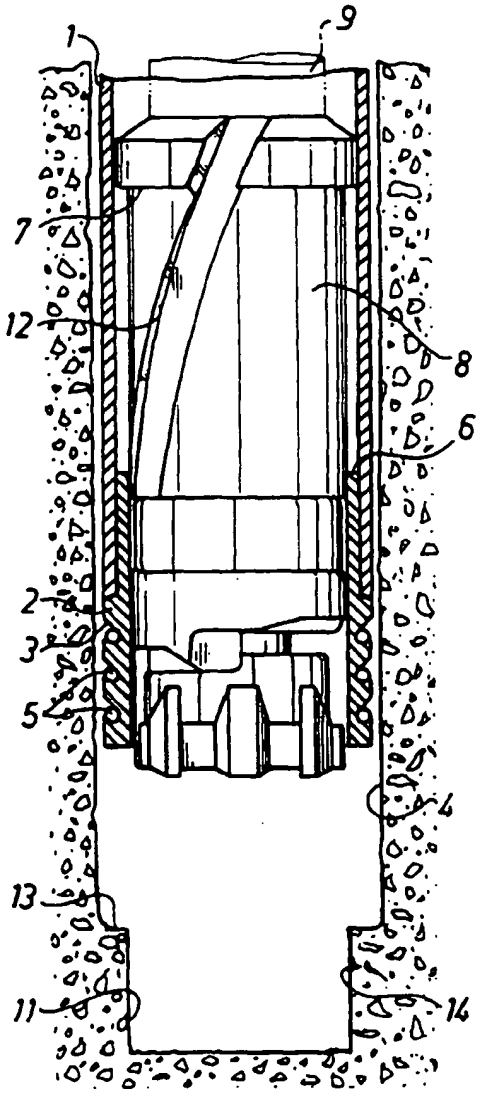

Fig. 2

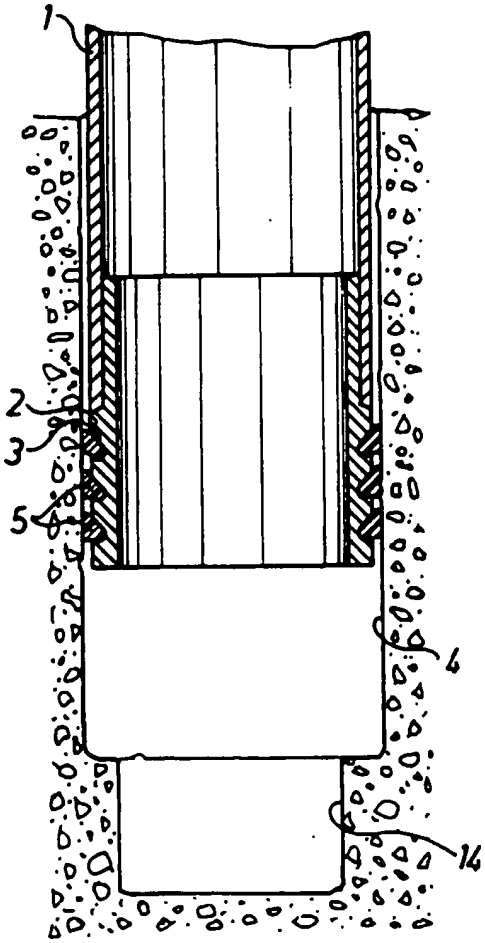

Fig. 3

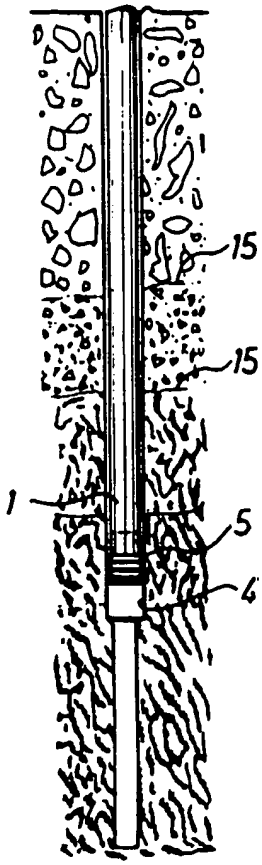

Fig. 4